



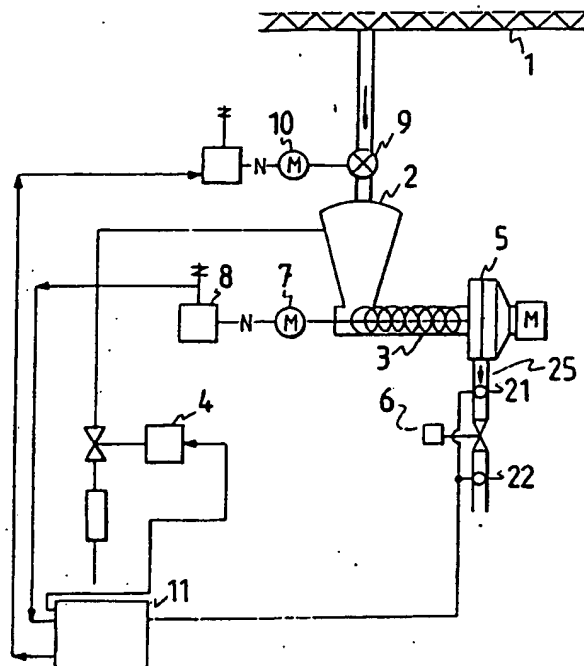
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup> :</b>  <b>D21D 1/20</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 89/ 00624</b>  <b>(43) International Publication Date:</b> 26 January 1989 (26.01.89)
<b>(21) International Application Number:</b> PCT/FI88/00118 <b>(22) International Filing Date:</b> 15 July 1988 (15.07.88) <b>(31) Priority Application Number:</b> 873120 <b>(32) Priority Date:</b> 15 July 1987 (15.07.87) <b>(33) Priority Country:</b> FI  <b>(71)(72) Applicants and Inventors:</b> PIETINEN, Pertti [FI/FI]; Korpikuja 31 as 10, SF-87200 Kajaani (FI). SAVONJOUSI, Aslak [FI/FI]; Vanha Rastalantie 10, SF-02620 Espoo 62 (FI).  <b>(74) Agent:</b> LAINE, Seppo; Seppo Laine Ky, Lönnrotinkatu 19 A, SF-00120 Helsinki (FI).		<b>(81) Designated States:</b> AT, AT (European patent), AU, BB, BE (European patent), BG, BJ (OAPI patent), BR, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.  <b>Published.</b> <i>With international search report.</i>

**(54) Title:** METHOD AND APPARATUS FOR CONTROLLING THE PRODUCTION OF REFINED STOCK

**(57) Abstract**

This publication discloses a method and an apparatus for controlling the production of refined stock. According to implementation of the invention, chips are metered by metering elements (3, 7) into a feed chest (2), feed elements (3, 7) adapted to the feed chest are used to feed chips for refinement between refining discs (5), and water is added to the chips prior to feeding the chips between the discs (5). According to the invention, moisture content of refined stock is measured after the refiner at least in a semi-continuous fashion by means of at least one measurement device (21, 22, 23, 24) operating on-line, and on the basis of measured moisture content, the quantity of chips and water to be metered is controlled in a conventional manner so as to regulate the moisture content to a desired level of constant value by, e.g., increasing the volume of metered chips and simultaneously decreasing the quantity of fed water for an increasing trend of moisture content, and correspondingly, applying an opposite strategy to counter a decreasing trend of moisture content. The implementation in accordance with the invention provides a consistent quality of refined stock.



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Method and apparatus for controlling the production of refined stock

5 The present invention relates to a method in accordance with the preamble of claim 1 for controlling the production of refined stock.

The invention also concerns an apparatus for the implementation of the method.

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In prior art methods, the feed of chips to the rotating refiner was under manual control of set values for chip entry and water feed. In the manual control method, control delay of some process set values is naturally extremely long, typically in the order of several hours. The selection of set values is approximate and inconsistent. Furthermore, since the consistency and size variation of entering chips is random, this method is incapable of producing consistent quality of refined pulp.

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Efforts have been made to estimate the water quantity of the chips entering the refiner, but approaches to a reliable moisture content sensor for chips have been unsuccessful.

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Known in the art are also adjustable systems, in which an attempt has been made to maintain power consumed by the refiner constant by regulating the quantity of fed water. Yet, although the power input from the mains to the refiner is maintained constant, refined stock presents consistency deviations due to variations in density of chips.

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Water feed is also controlled by first measuring the freeness value of refined stock which gives a standardized measure for pulp drainage and is characteristic of the quantity of fines in the stock, and then, on the basis of determined freeness, adjusting water quantity, production

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capacity, and disc clearance to obtain desired freeness value. This method, however, is insensitive to changes in consistency and density. In addition, freeness measurement is time consuming, and consequently, does not lend to real-time control, but rather presents an appreciable delay between the time of measurement to that of control.

The aim of the present invention is to overcome the disadvantages associated with the prior art technology and achieve a totally new kind of method and apparatus for controlling the production of refined stock.

The invention is based on measuring in a continuous manner the moisture content of refined stock emerging from the refiner so as to use the measured value for controlling the ratio of additional water to volume of fed chips to a desired level.

More specifically, the method in accordance with the invention is characterized by what is stated in the characterizing part of claim 1.

Furthermore, the apparatus in accordance with the invention is characterized by what is stated in the characterizing part of claim 4.

The invention provides outstanding benefits.

With help of moisture content measurements of refined stock, disturbance created by variations in moisture content can be eliminated. As the moisture content is under control, the production machinery can be run at higher capacity resulting in an increase in efficiency.

The invention is next examined in detail with help of the following exemplifying embodiment illustrated in the attached drawings.

Figure 1 shows diagrammatically a control system in accordance with the invention.

5 Figure 2 shows diagrammatically another control system in accordance with the invention.

Figure 3 shows in a partially diagrammatic form a measurement set-up connected to the control system illustrated in Fig. 1.

10 Figure 4 shows diagrammatically a principle of infra-red measurement.

Figure 5 shows diagrammatically a measurement set-up of infra-red measurement.

Figure 6 shows in the form of a graph the correlation of the infra-red measurement method to laboratory verifications.

20 According to Figure 1, wood chips to be refined are conveyed to the refinery by conveyor 1. The chips are fed and metered with help of a feeder 9 rotated by a metering pump 10 to a feed chest 2 of the refiner, from where the chips are further fed into the gap between the refining discs 5 by a  
25 feeder auger 3 rotated by a feeder motor 7. In the feed chest 2 or within the auger tube 3, water is added by a volume regulated by a controller 4. Between the discs 5, the chips are ground into a refined stock, and the generated steam expels stock forward via a control valve 6. The  
30 purpose of the control valve 6 is to maintain a constant steam pressure. After the discs 5, prior to the valve 6, a moisture sensor 21 is arranged to the outlet pipe 25. A corresponding sensor 22 may also be placed on the route of the refined stock after the control valve 6. The obtained  
35 moisture signal is taken to the controller 4 or to a data processing unit 11. If the humidity of refined stock falls

below a desired set value, water volume in the chips is increased by either reducing feed rate of chips or increasing volume of added water using a conventional control method. For an excessive moisture content, the opposite is true. In practice the control operation takes place by sending a new set value to the controller 4 from the data processing unit 11.

According to Figure 2, two refiners are connected in tandem. However, the number of moisture content measurement points is greater. A moisture content sensor 23 may be located to the outlet pipe of the second refiner. A sensor 24 may also be placed to a point after a cyclone 12 in, e.g., the outlet pipe of the cyclone. Each sensor 21, 22, 23, and 24 is advantageously arranged to have independent function and transmission of sensor signals to a data processing unit 11, whereby the signals may either be selected for an optimum singular signal best describing the process or be subjected to a mathematical processing by, e.g., averaging, to obtain a suitable control signal. In some cases a single sensor may be sufficient. Both refiners are provided with identical control equipment 4 of water addition according to the set-up in Fig. 1. The set values for the refiners, however, may be different.

Illustrated in Figure 3 is a measurement set-up attached to an outlet pipe 25 of the refiner allowing a bypass pipe 42 to be configured to the stock flow. The pipe 42 is provided with a choke valve 26 for controlling the bypass flow. The steam developed by stock expanding to a larger volume is removed via a condenser 43, and the refined stock is transferred by means of an auger 45 rotated by a motor 44 to moisture content sensors 27 and 28. For making nontransmissive infra-red measurements, sensor unit 27 is sufficient. When using microwave measurement, a receiver unit 28 is additionally required.

According to Figure 4, the infra-red equipment operates by sending IR light from an IR source 29 via a filter disc 30, and the filtered light is dispersed by water molecules 32. The dispersed radiation is detected by a detector 31. Water molecules 33 remaining under the surface escape detection.

In the embodiment illustrated in Figure 5, light emerging from the IR source is routed via lenses 35 and mirrors through a filter unit 36, and via a mirror 38 to a target 39. The filter unit 36 is provided with a chopper unit 37 for chopping the light beam. Light reflected from the target 39 is routed to a light-dependent resistor 40 acting as an IR detector, and the output signal of the resistor 40 is amplified by an amplifier 41.

Direct measurement of stock moisture content under pressure is also feasible by mounting a transparent section to the stock pipe. When using the aforescribed IR measurement, a mere transparent window will suffice.

When using microwave measurement, a sender unit 27 and a receiver unit 28 are located to the opposite sides of the stock pipe. The stock pipe must be of a microwave-transparent material, e.g., teflon, at least for the section used in the microwave measurement.

Figure 6 illustrates the correlation of moisture content from IR measurements to laboratory verification results. In the moisture content measurement session, the output signal of the moisture content sensor was 2.30 V, the flow rate of additional water was then 85 l/min, and the freeness was 145 CSf. After a change in the moisture of entering chips, the sensor signal was 2.41 V, and the corresponding freeness was 153 CSf. The controller adjusted the rate of water addition to a level of 78 l/min, resulting in the return of the sensor signal to a level of 2.32 while the corresponding

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In the embodiment illustrated in Figure 5, light emerging from the IR source is routed via lenses 35 and mirrors through a filter unit 36, and via a mirror 38 to a target 39. The filter unit 36 is provided with a chopper unit 37 for chopping the light beam. Light reflected from the target 39 is routed to a light-dependent resistor 40 acting as an IR detector, and the output signal of the resistor 40 is amplified by an amplifier 41.

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freeness was 142 CSf. No major changes were detected by the measurements in the moisture content of chips. Consequently, a direct measurement of moisture content from the chips was unsuccessful, because the sensor measures only the surface moisture of chips.

## WHAT IS CLAIMED IS:

1. A method for controlling a refiner, in which method

5 - chips are metered into a feed chest (2) of the refiner by metering means (10, 9),

10 - chips are transferred for refinement between refiner discs (5) by feeder means (3, 7) arranged in connection with the feed chest (2), and

15 - water is added to the chips by water metering means (10) prior to feeding the chips between the refiner discs,

c h a r a c t e r i z e d in that

20 - the moisture content of refined stock is measured after the refiner at least in a semicontinuous fashion by means of at least one measurement device (21, 22, 23, 24) operating on-line, and

25 - on the basis of measured moisture content, the quantity of chips and water to be metered is controlled in a conventional manner so as to regulate the moisture content to a desired level of constant value by, e.g., increasing the volume  
30 of metered chips and/or decreasing the quantity of fed water for an increasing trend of moisture content to obtain a comparable effect, and correspondingly, applying an opposite strategy to counter a decreasing trend of moisture content.

35 2. A method in accordance with claim 1, characterized in that the pipe exiting the

refiner is provided with a transparent pipe section, through which the moisture content is measured using a conventional infra-red measurement method.

5        3.        A method in accordance with claim 1, characterized in that the pipe exiting the refiner is provided with a microwave-transparent pipe section, through which the moisture content is measured using a conventional microwave measurement method.

10       4.       An apparatus for controlling a refiner, comprising

- metering means (10, 9) for metering chips into a refiner,

15       - feeder means (3, 7) for feeding the chips between refiner discs (5) to be refined, and

20       - water metering means (10) for feeding water into the chips prior to feeding the chips between the refiner discs (5),

characterized by

25       - moisture content measuring elements (21, 22, 23, 24) arranged along the passage of chips after the refiner discs (5) in order to determine the moisture content of chips, and

30       - control means (11, 4) for controlling the metering means (10, 9), the feeder means (3, 7), and the water metering means (10) on the basis of moisture content values received from the measuring elements (21, 22, 23, 24) to maintain a  
35       constant moisture content of refined stock.

refiner is provided with a transparent pipe section, through which the moisture content is measured using a conventional infra-red measurement method.

5        3.        A method in accordance with claim 1, characterized in that the pipe exiting the refiner is provided with a microwave-transparent pipe section, through which the moisture content is measured using a conventional microwave measurement method.

10       4.       An apparatus for controlling a refiner, comprising

- metering means (10, 9) for metering chips into a refiner,

15       - feeder means (3, 7) for feeding the chips between refiner discs (5) to be refined, and

20       - water metering means (10) for feeding water into the chips prior to feeding the chips between the refiner discs (5),

characterized by

25       - moisture content measuring elements (21, 22, 23, 24) arranged along the passage of chips after the refiner discs (5) in order to determine the moisture content of chips, and

30       - control means (11, 4) for controlling the metering means (10, 9), the feeder means (3, 7), and the water metering means (10) on the basis of moisture content values received from the measuring elements (21, 22, 23, 24) to maintain a  
35       constant moisture content of refined stock.

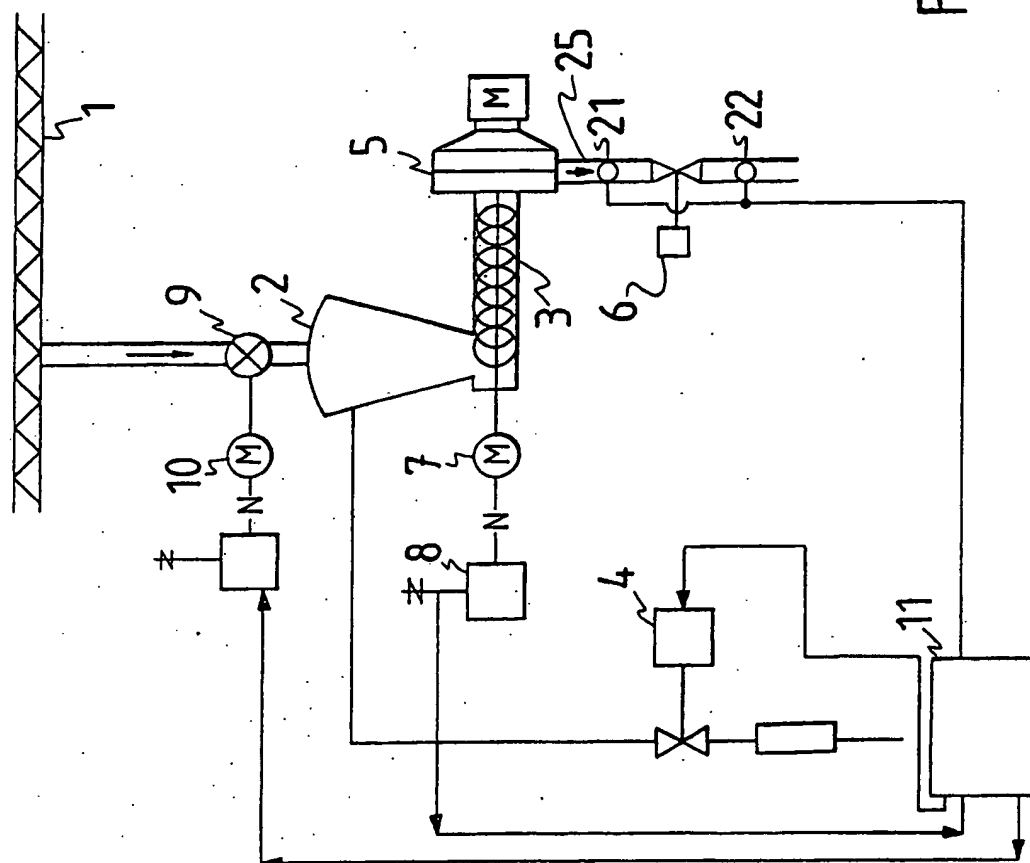
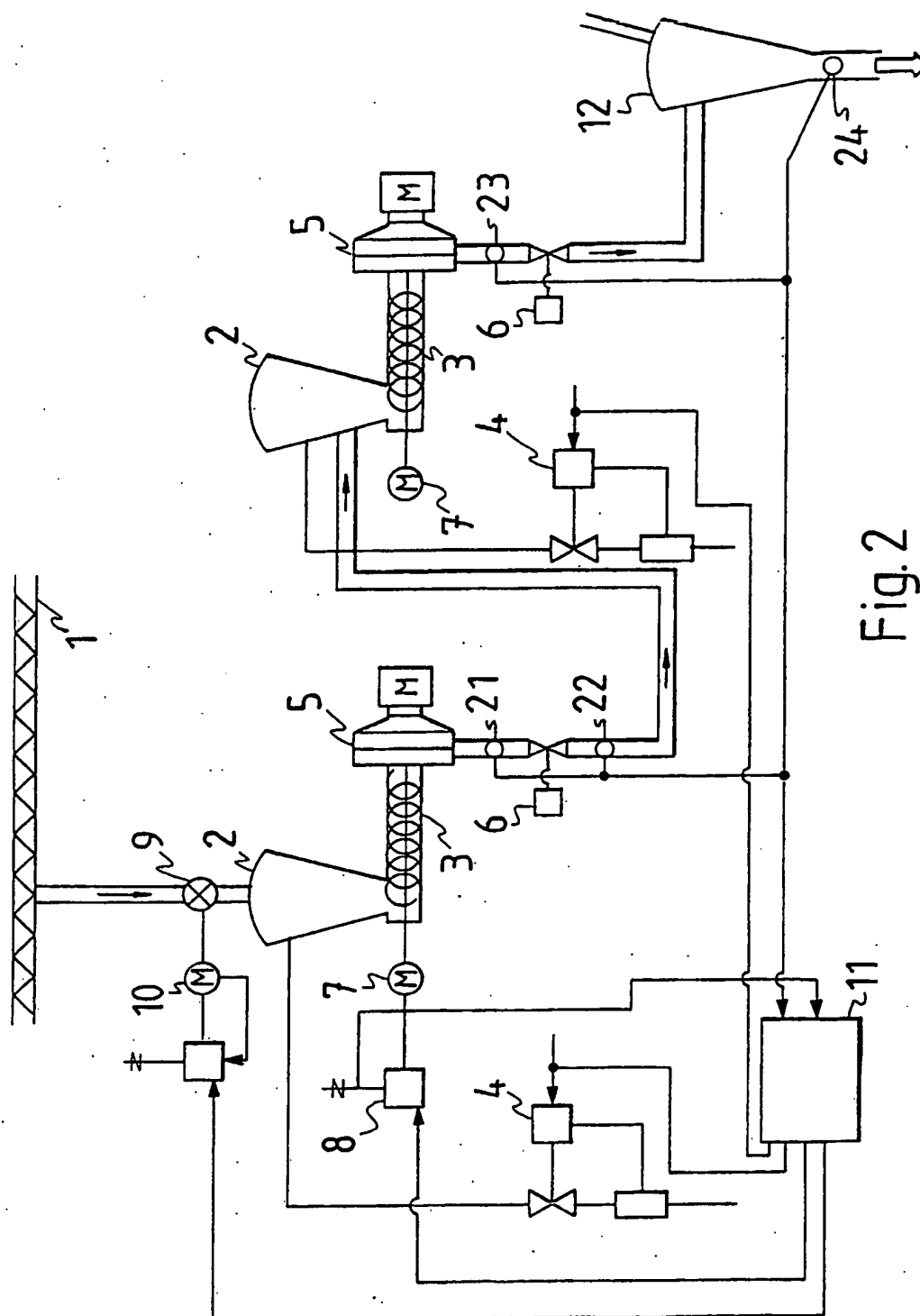


Fig. 1



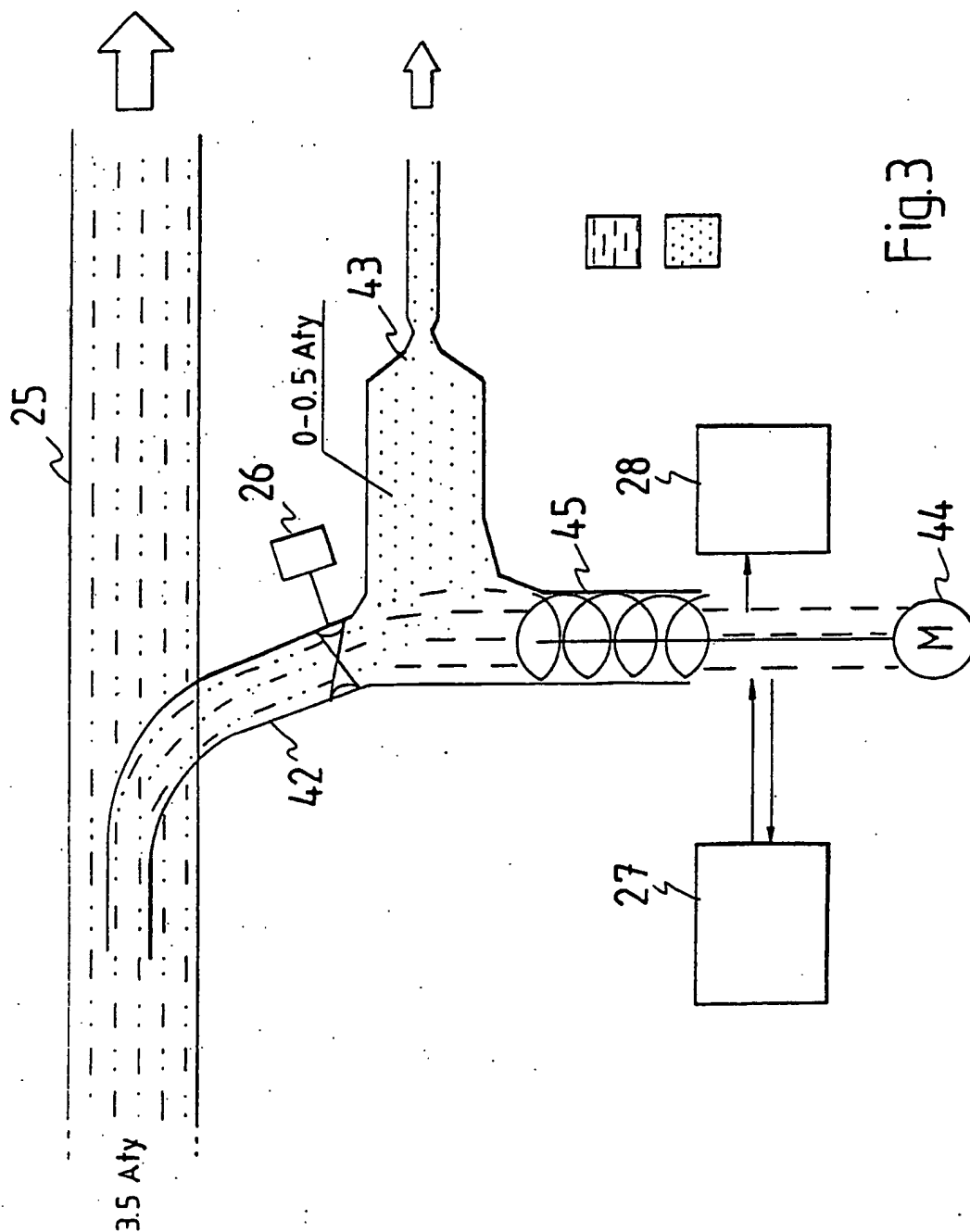


Fig. 3

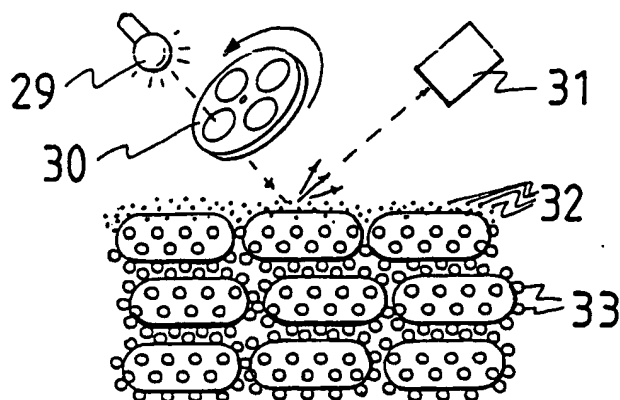


Fig. 4

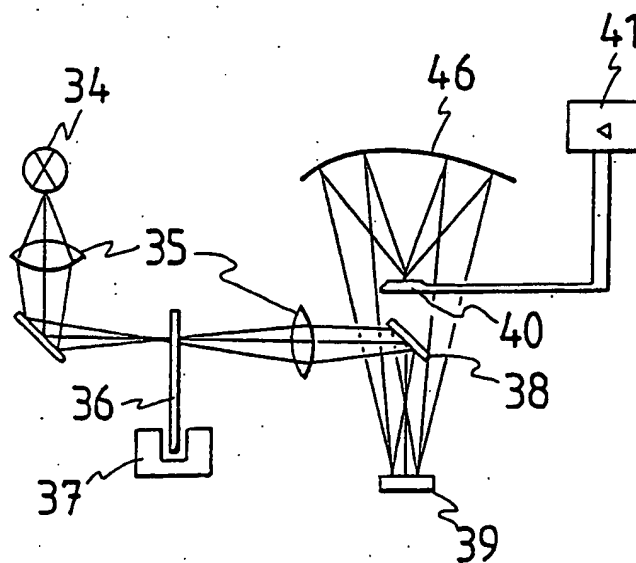


Fig. 5

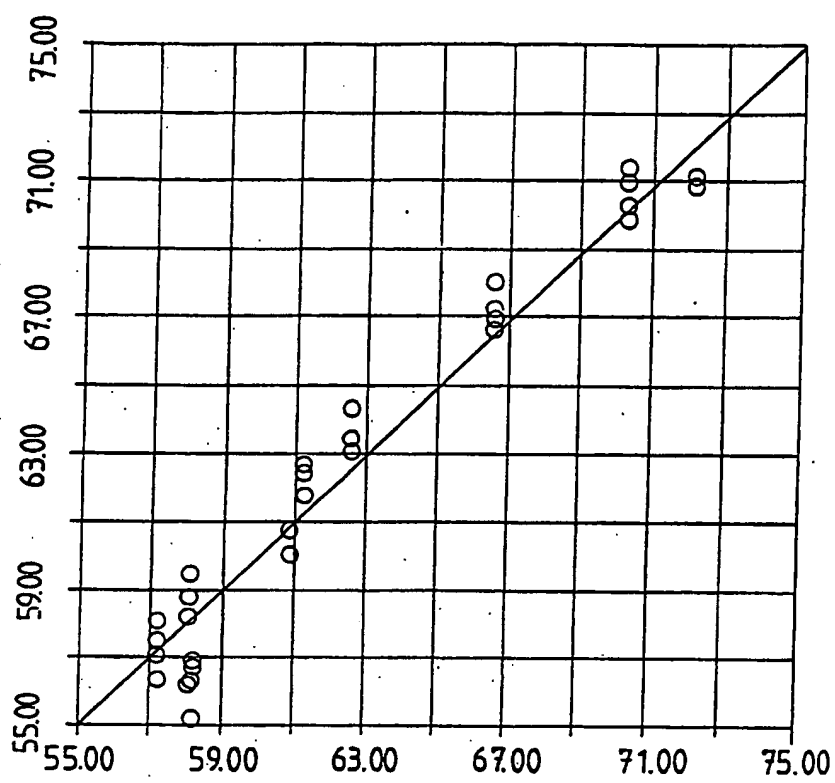
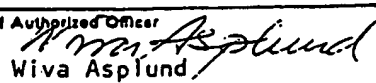


Fig.6

# INTERNATIONAL SEARCH REPORT

International Application No. **PCT/FI88/00118**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC <sup>4</sup> <div style="text-align: center; padding: 5px;">D 21 D 1/20</div>										
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; padding: 5px;">Minimum Documentation Searched <sup>7</sup></div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; padding: 5px;">Classification System</th> <th style="padding: 5px;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;">IPC 4</td> <td style="padding: 5px;">D 21 D 1/00, /02, /20-/30; B 02 C 25/00</td> </tr> <tr> <td style="padding: 5px;">Nat. CI</td> <td style="padding: 5px;">55c 11/01</td> </tr> <tr> <td style="padding: 5px;">US CI</td> <td style="padding: 5px;">162: 252, 258, 261; 241: 15, 21, 28, 30, 33, 34, 38, 245, 251</td> </tr> </table> <div style="text-align: center; padding: 5px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div> <div style="padding: 10px; margin-top: 10px;">SE, NO, DK, FI classes as above</div>			Classification System	Classification Symbols	IPC 4	D 21 D 1/00, /02, /20-/30; B 02 C 25/00	Nat. CI	55c 11/01	US CI	162: 252, 258, 261; 241: 15, 21, 28, 30, 33, 34, 38, 245, 251
Classification System	Classification Symbols									
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Nat. CI	55c 11/01									
US CI	162: 252, 258, 261; 241: 15, 21, 28, 30, 33, 34, 38, 245, 251									
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; padding: 5px;">Category <sup>9</sup></th> <th style="width: 70%; padding: 5px;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 20%; padding: 5px;">Relevant to Claim No. <sup>13</sup></th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 10px;">X</td> <td style="padding: 10px;">           US, A, 2 437 715 (CLARK E THORP et al)            16 March 1948            see claim 1            &amp; GB, 638320         </td> <td style="text-align: center; vertical-align: top; padding: 10px;">1, 2, 4</td> </tr> </table>			Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	X	US, A, 2 437 715 (CLARK E THORP et al) 16 March 1948 see claim 1 & GB, 638320	1, 2, 4		
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X	US, A, 2 437 715 (CLARK E THORP et al) 16 March 1948 see claim 1 & GB, 638320	1, 2, 4								
<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p><sup>*</sup> Special categories of cited documents: <sup>10</sup></p> <p><sup>"A"</sup> document defining the general state of the art which is not considered to be of particular relevance</p> <p><sup>"E"</sup> earlier document but published on or after the international filing date</p> <p><sup>"L"</sup> document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p><sup>"O"</sup> document referring to an oral disclosure, use, exhibition or other means</p> <p><sup>"P"</sup> document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p><sup>"T"</sup> later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p><sup>"X"</sup> document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p><sup>"Y"</sup> document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p><sup>"A"</sup> document member of the same patent family</p> </div> </div>										
<b>IV. CERTIFICATION</b>										
Date of the Actual Completion of the International Search <div style="text-align: center; padding: 5px;">1988-11-04</div>	Date of Mailing of this International Search Report <div style="text-align: center; padding: 5px;">1988 -11- 08</div>									
International Searching Authority <div style="text-align: center; padding: 5px;">Swedish Patent Office</div>	Signature of Authorized Officer <div style="text-align: center;">             Wiva Asplund         </div>									